Career Advice

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This note has my two cents for engineers at various stages of their education and career, based on experience in advising students over many years.

Undergraduate Internships

The earlier you can get a paid technical internship, whether for research at the university or some development project at a company, the better. Having the first technical job makes it much easier to get later ones, and you have the chance to sample different work cultures. But how do you find that internship? The answer is to exploit whatever career resources are available at your university (e.g., resume prep, career fairs) as well as all personal connections (family, student organizations, classmates, professors). You also need a story: the fact that you did well in courses is not nearly as interesting as successful teamwork on some open-ended problem, technical or not. That's because such a story illustrates creative pursuit and working well with others, and you're likely to be much more enthusiastic and knowledgeable as you tell it. Teaching experiences (tutoring, outreach programs) are also great topics. Both can be obtained by being involved in a student design organization, which has the bonus of interacting with many students who have obtained technical internships and can discuss the relative merits of various employers. My own internship was obtained by perusing the list of companies offering internships to first-year students in a coop program at another university; I obtained the list from a high school friend. My reasoning was that if they'd hire from that rival university, they'd certainly hire from ours. This turned out to be correct: the VP of the start-up was an alum of ours. I stayed with them for four summers; the work spurred my interest in telecommunications and resulted in excellent advice for who to seek out as a Ph.D. advisor. The moral of the story: don't be shy about using your connections.

More School vs. Industry

The main considerations on whether to go to grad school or industry following undergraduate studies come down to financial need and desire to do design. The longer you stay in school, the longer in your career (on average) you will be working on design-oriented tasks or research. Roughly, with a BS one works on development tasks for the next product generation, with an MS one can expect to (after some job experience) lead a small technical group and help determine the technical specifications for the next product generation, and with a Ph.D. part of the job is to work on more speculative projects that can shape future product generations. Another way of looking at it is the risk associated with the work: with a BS, most tasks are for things that are near-certain to work, with an MS some of the alternatives will be discarded, and with a PhD many of the alternatives will not be workable, but some might be game-changing. In academia, the time frame for practical applications is longer and the risk/reward tradeoff is more extreme. This is

because in academia part of the research objective is training students to do research, and the training is better and usually more fun if the project is higher risk.

There are certain job categories for which a BS is completely sufficient (e.g., being a programmer). But there are others where an MS is essential (e.g., to be a circuit designer, advanced courses and tools are needed). An MS is also generally needed to go on for an MBA (they like management experience) or to become a patent attorney (to give a domain of technical expertise). Discuss it with an advisor whose expertise is in your chosen field of interest.

If you are tired of school, the choice of going to industry is obvious. There are many interesting career tracks that don't involve much design. If you are interested in design but need the money right away, then my advice is to continue to live like a student while you are working. By saving money instead of going into more debt for a fancy car or the luxury of life without roommates, you will preserve the freedom to go back to school, leave for a different employer, or save for a down-payment on a house. While it is true that the American way is to get into unrecoverable debt with credit card companies, this is not the path to accomplishment of your life-goals. Another thing to consider is whether the company will pay for graduate school, typically with strings attached like committing to x years of service post-degree or else paying back the money. Asking about continuing education is a good interview question: it shows you're ambitious in the profession. If they don't make accommodations or have robust internal skills training, this is a red flag. Without ongoing training, what is their strategy for staying technically ahead of the competition? Speaking of interviews, you are interviewing them as much as they are interviewing you. If it's onsite, do the team members seem to like each other? (This is most apparent at lunch). If they don't, run away. While company reputation matters somewhat, what's most important to your happiness and technical development is the group you interact with day by day.

Post-PhD Options

Having a PhD certifies that you can learn some topic as deeply as anyone else in the world. If you can do it once, you can do it again in some other related area. There are different options for applying this skill in industry and academia.

You can postpone your decision somewhat by choosing to pursue a postdoc. This has the advantage of showing that you can produce productive research on a different topic in another group. This is a good option if your goal is academia, but you're often better off earning real money at a company straight off if your goal is corporate R&D. Back in the time of large autonomous corporate research organizations such as Bell Labs, postdoc positions weren't common for engineers seeking academic jobs: experience could be obtained at corporate research labs at industry salaries. These days, there are fewer such opportunities, although some persist, and there are some excellent government labs that encourage publications.

Most corporate R&D is much heavier on the D. But practical problems often of necessity become research problems since no one has pushed a technology in that particular way before. Large resources can be available, with the tradeoff being that the topics to be investigated must be relevant to the product being developed. Large practical impacts are possible. As usual in choosing between companies, what matters most is the particular team you'll be joining and your assessment of the realism of their business plan. Note that you can, depending on the organization, at a later point in your career do some teaching as a lecturer or adjunct at a neighboring university or college. This is mutually beneficial, as it helps to recruit good students to the company or lab, and you get to scratch your teaching itch.

In academia there is a choice between universities with high teaching loads (e.g., 6 courses per year) and limited research expectations, and those with more limited teaching (2-3 courses per year) and high research expectations. The first thing to decide is whether you like teaching. If you don't, even for the so-called research universities, you are better off going to industry or a government lab. This is because university research includes teaching graduate students how to do research. One way or another, you are spending a lot of time with students. Your life will be miserable if you don't enjoy teaching them, but can be magical if you do. As for research vs. teaching institutions, be aware that getting money for research is almost its own full-time job with a failure rate approaching high-risk research. It has become far more competitive over my more than three decades as a professor, due to a lesser share of national resources going to R&D and more universities competing for the remaining funds. You need to really believe in the value of your research vision to sustain the effort. Given how much things vary by sub-discipline, this is a topic you need to discuss with multiple faculty (e.g., at least all the members of your PhD committee, or faculty within your discipline at your postdoc institution, as applicable). University cultures also vary in the amount of assistance provided at the beginning of a career; having a caring mentor is more important than ever in getting launched.

Work Life Balance

How much of your time you are willing to devote to work also plays a role in which employer to accept an offer from. My first post-Ph.D. job at a big company had something that's almost gone away: a fixed work week of less than 40 hours, with plenty of time for other activities after work was done. By contrast, start-ups are often exciting: in return for long hours, you learn many diverse skills in a short period of time. There is of course the risk of the start-up tanking; few get bought or go public. But you can usually figure out in a relatively short time whether things are going well or not, and if not, jump ship so long as you have the magic two years of post-degree work experience and have saved some money to survive brief unemployment. However, long hours are usually not sustainable. They are incompatible with the needs of most spouses and all children. Academia has a similar risk, because at a research university it is actually multiple jobs: research, teaching, and getting money for research, with substantial administrative work often waiting for you after tenure. So, at some point, you will need to

be in a job that either has boundaries on work, or you need to be in a job where you can set the boundaries yourself.

Note that besides setting boundaries on time, you need to set boundaries on spending. While engineers are paid well, by creating a budget that includes savings for retirement and philanthropy for the causes you believe in, you can prioritize your spending on the things that give you the most happiness. Credit card debt should be paid off every month, except in emergencies such as unexpected major health bills. You can't afford it if you can't pay for it immediately, except for capital assets like houses and cars. By living this way, the lure of a job that pays more but demands more hours is diminished, and instead you can work the number of hours that are compatible with your life priorities.

Depending on how you look at it, I was fortunate or unfortunate in having my first job set the pattern for my subsequent academic career: next to no work when I got home to allow ample time for athletics, reading, spiritual renewal, music, and being with friends and loved ones. It was fortunate because now as I approach retirement I have so many other interests in my life that I'm excited to explore; possibly unfortunate because I didn't climb as high in the profession as I sometimes imagine I might have with a more single-minded pursuit. The point is that you need to set for yourself a balance that works for you and your loved ones, and this balance will shift as your life circumstances change. In youth, there is more energy, and prior to being in a serious relationship more time can be devoted to getting ahead in your career. But for most people, the pressures build over time and a different set of priorities is needed, or else it becomes a rat-race. As Delilah seductively sings in Handel's oratorio *Samson*, "all happiness is love enjoyed." This can be love of some aspects of your work or your hobbies, but mainly, it is love of other people. And that love requires time to cultivate so that you can enjoy its bountiful harvest, year after year.